# THE SPECTROGRAPHIC ANALYSIS OF STUTTERER'S SPEECH UNDER DELAYED AUDITORY FEEDBACK

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The development and influence of cybernetics has given rise to a number of hypothetical models, such as those by Fairbanks (1954) and Mysak (1966) which describe the essential monitoring system for speech as closed feedback loops and have concluded that any disruptions in the monitoring system might lead to speech disturbances.

Left (1950, 1951) and Black (1951) first reported about delayed auditory feedback. When a normal speaker's verbal output was fedback to his ears after a short delay of about 200 m. secs, marked breaks in fluency occurred.

Some (Nessel, 1958 ; Lotzmann, 1961 ; Soderberg, 1969 ; Adamezyki, 1959 ; Goldiamond, 1965) have demonstrated marked reduction in stutterings.

Variations in the vocal intensity and pitch (Logue, 1962) and variations in rate of speech (Nessel, 1958 ; Soderberg, 1969) under DAF were observed in stutterers.

Attempts have been made to study the stuttering in terms of its acoustic characteristics stutterers' showed a longer voice onset time for voiceless and Voiced stop consonants white reading and also in isolation (Adams and Reis. 1971 ; Hillman and Gilber, 1977 ; and Basu, 1979). Prolongation of vowels and glides weer observed under delayed auditory feedback in normals (Agnello, 1965).

The present study is aimed at spectrographically, analysing the different parameters of speech such as, voice onset time, vowel duration, vocal level, fundamental frequency of voice. Of stutterers and non stutterers under delayed auditory feedback and normal auditory feedback. Rate of speech and number of stuttering blocks of stutterers and non-stutterers were also computed under delayed auditory feedback.

Subjects : Four male stutterers in the age range of 15 to 25 years with approximately same level of reading proficiency, and same mother tongue with no history of speech and/or hearing problems other than stuttering were

selected as experimental group. Four male normal subjects were matched for age, mother tongue and reading proficiency served as control group. They had no history.of speech and/or hearing problems.

Reading material : Two passages with same number of syllables and having predetermined words for spectrographic analysis in both the passages were constructed. These were meaningful, non-emotional passages.

Procedure; Both stutterers and non-stutterers read the passages (on each) under two conditions. (1) Delayed auditory feedback (2) Normae auditory feedback.

The readings were recorded on the Tape recorder of Speech Spectrograph (Voice Identification, I MC-700-Series). A DAF Unit (Aberdeen speech and Model DA1-2) provided a binaural delay of 200 m.sec.through earphones. The microphone of the DAF unit was clipped to the collar and the distance between mouth to microphone was maintained constant for all subjects/ Similarly the recording microphone .was kept at a constant distance from the mouth of the subject for all subjects. All the recordings were done in the Speech laboratory of All India Institute of Speece and Hearing, Mysore.

The recorded data was subjected to analysis. The Speech Spectrograph, (VlC-700 Series) was used to measure VOT and vowel duration by obtaining, the b'oad band spectrograms. Digipitch (DPM 10 S) was used to measure fundamental frequency and measuring amplifier (B & K 2606) was used to measure vocal intensity level. Wingates (1964) definition of stuttering was-used in counting the number of stuttering blocks and rate of speech wag/ calculated by finding the number of syllables read per second. Three post-graduate speech pathology students were selected as judges to count the dumber of blocks.

## RESULTS AND DISCUSSION

Results were inferred and discussed on the basis of the significance of mean difference obtained for experimental and control group for different variables using 't' test.

The results of analysis for stutterers and non-stutterers are shown in Table-1 arid Table-2 respectively.

TABLE-1

Showing the mean values of different variable studied under DAF and NAF for stutterers.

| Variables | | DAF | NAF |
|---|---|---|---|
| No. of stuttering blocks | | 17.32 | 19.32 |
| Fundamental frequency | | 123.16 Hz | 120.07 Hz |
| Reading Rate | | 2.40 | 2 67 |
| Vocal Intensity | | 86.15 dB | 83.15 dB |
| Voice onset time | (t) | 11.25 m. Sec | 13.75 m. Sec |
| | (t) | 8.75 m. Sec | 11.25 m. Sec |
| | (k) | 10.00 m. Sec | 20.00 m Sec |
| Vowel duration | (a) | 167.50 m. Sec | 106.25 m. Sec |
| | (i) | 96.25 m. Sec | 105.00 m. Sec |
| | (u) | 105.00 m. Sec | 122.50 m. Sec |

**TABLE-2**

Showing the mean values of different variables studied under DAF and NAF for non-stutterers

| Variables | | DAF | NAF |
|---|---|---|---|
| No. of blocks | | 10 | 0 |
| Fundamental frequency | | 144.93 | 121.10 |
| Reading rate | | 4.16 | 6.03 |
| Vocal intensity | | 94.01 dB | 88.33 dB |
| Voice onset time | **0)** | 13.33 m. Sec | 12.50 m. Sec |
| | (t) | 13.75 m. Sec | 11.25 m. Sec . |
| | (k) | 16.25 m. Sec | 15.00 m. Sec |
| Vowel duration. | (a) | 100.00 m. Sec | 90.00 m. Sec |
| | (i) | 151.25 m. Sec | 86.25 m. Sec |
| | (u) | 142.50 m. Sec | 116.25 m. Sec |

Non-stutterers showed reduction in rate of speech under DAF when compared to NAF. This supports the results of Fairbanks (1955, 1958)- Non-stutterers took longer time to read the passages under DAF which is in support of the findings of Nessel (1958). Stutterers took longer time to read the passages under DAF which goes in contrast with the results obiained by Nessel (1958) who found majority of the stutterers demonstrated no appreciable change in the reading time under DAF and NFA conditions.

There was reduction in the number of stuttering blocks of stutterers under DAF which is in agreement with the results of Chase, Sutton (1961) ; Soderberg (1969) ; and Goldiamond (1965). On the contrary non-stutterers stuttered under DAF which supports the findings of Nataraja, Ramesh and Ra kumar (1982).

There was increase in the fundamental frequency of non-stutterets under DAF and stutterers showed HO significant change in the fundamental Frequency under DAF. This finding goes in contrast with the findings of Soderberg (1969) who found increase in fundamental frequency in stutterers under DAF.

Stuterers showed slight reduction in VOT under DAF and in contrast non-stutterers had an increase in VOT under DAF. Basu|(1979) has indicated that stutterers showed a longer VOT for voiced and voiceless consonants in reading under NAF.

It was found that /k/ consonant had maximum VOT for stutterers under NAF and for nonstutterers in both NAF and DAF which supports the findings of Lisker and Abramson 1964 ; Basu 1979 who found..... "as the position of articulation moves backward in the oral cavity, the VOT also increases".

There was increase in the duration for all the three vowels in non-stutterers when they read the passages under DAF Rawnsley and Harris (1954) and Agnello (1965) also found prolongation of vowels in nonstutterers under DAF. Stutterers had a reduction in vowel duration for /i/ and /u/ but the duration of the vowel /a/ was increased under DAF.

Both stutterers and non-stutterers showed negligible variations in intensity whie reading under both DAF and NAF conditions.

The following conclusions were drawn from this study.

1. The non-stutterers show stuttering like behavior under DAF whereas stutterers show reduction in number of stuttering blocks under DAF.

2. The non-stutterers take more time to read a passage under DAF than under NAF, whereas stutterers take less time to readra passage under DAF than under NAF.

3. The non-stutterers show increase in fundamental frequency of their voice while reading under DAF and stutterers show negligible or no change in fundamental frequency while reading under DAF.

4. There is negligible or no significant change in VOT of stutterers and non-stutterers while reading under DAF.

5. There is negligible or no significant change in the vowel duration of stuttered and non-stuttered while reading under DAF.

6. There is negligible or no significant change in the vocal level of stutterer and non-stutterers while reading under DAF.

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